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GRANULITES FROM NORTHWEST INDIAN SHIELD : THEIR DIFFERENCES AND SIMILARITIES WITH SOUTHERN INDIAN GRANULITE TERRAIN. R.S.Sharma, Department of Geology, Banaras Hindu University, Varanasi-221005, India

Granulite facies suite in NW Indian Shield is exposed at Sand Mata, Udaipur district, Rajasthan, as an oval-shaped massif within amphibolite facies rocks of the Banded Gneissic Complex (3.5 to 2.6 b.y. old) — a possible analogue of the Peninsular gneiss of Dharwar craton. The contact of the granulites with the surrounding gneisses is demarcated by a shear zone of 10 to 15 m width with a steep down dip lineation. The granulites have a general strike of N-S to NNW-SSE, with gentle to high dips towards east, and record three fold phases. The first (F_1) is seen as rootless folds with W to SW trending axial planes. The second folds (F_2) are isoclinal or reclined with NW-SE to N-S trending axial planes. The third phase (F_3) is characterized by vertical to very steep fold axes, producing vortex or 'Schlingen' structure.

The granulite suite of Sand Mata consists three main rock types. Amongst them the pelitic granulite dominates and contains garnet, biotite, sillimanite, kyanite, quartz, feldspar and occasionally cordierite. Within this granulite gneiss occur discrete bands of charnockite and enderbite along the strike of the gneiss from which they seem to have derived. Interlayered with the pelitic granulite is another lithotype, the garnet leptynite containing garnet-quartz-feldspar, which at places shows gneissic fabric. The pelitic granulite-leptynite association is traversed along and across the banding by smoky and blue quartz veins and by pegmatites of at least three generations, sometimes with garnet. At the structural base of the banded granulite is the third rock-type, the garnet-bearing basic granulite which together with the

other two lithologies build the well-known granulite complex of Sand Mata. The complex is intruded by norite dykes of uncertain age, with crystallization temperature of about 1150°C .¹

Mineralogical studies show that in the basic granulite the orthopyroxene-plagioclase pair is incompatible and is separated by corona of garnet-clinopyroxene-quartz, suggesting it to be a high pressure granulite.² Random orientation of the corona minerals suggests that the granulite facies metamorphism occurred in a deformation-free environment, akin to charnockite forming conditions in the southern Indian Shield. The pelitic granulite is characterized by overprinting of kyanite by sillimanite which, in turn, is followed by growth of second generation kyanite, mostly in the form of needles. These assemblages are thus consistent with the polymetamorphic character which is also found in schists of the gneissic complex from north-central Rajasthan.³ The norite dyke shows blastophitic texture as well as metamorphic growth of garnet at the interface of plagioclase and hypersthene, suggesting that the dyke was emplaced during waning stages of granulite facies metamorphism. The mineralogy of the norite dyke further suggests that the corona texture in the garnet-bearing basic granulite has not formed during cooling.

Estimates of temperature conditions by different geothermometers give values which cluster about 850°C and 650°C for the basic assemblages and $650^{\circ} \pm 50^{\circ}\text{C}$ for the pelitic assemblages. These two concentrations of temperature values (850° and 650°) possibly are suggestive of climactic and blocking temperatures respectively during the granulite facies metamorphism. Application of different geobarometers to the investigated assemblages yields pressures in the vicinity of 5 ± 1 kb and 10 ± 2 kb. Interestingly, the pressure estimate for the garnet-core composition is lower than that for the

garnet-rim composition by the same equilibria involving cordierite in the pelitic composition. Higher pressure values for the rim than for the 'core' composition of garnet are also found in the anhydrous garnet-plagioclase- Al_2SiO_5 -quartz equilibria. This feature suggests that there was loading during cooling of the Sand Mata rocks. The concentration of P values at about 8-11 kb and near 5 kb, with almost no record of intermediate values perhaps indicates that the rocks were suddenly transported from deeper levels and emplaced to shallower depths (ca. 5 kb) where frozen-in equilibrium was attained in the assemblages. This is evidenced by the occurrence of the peripheral shear zone. This situation is in marked contrast with the granulitic rocks of southern Indian Shield. Also, there is no transitional facies rocks in the Sand Mata area, unlike that in the Dharwar craton.

On the basis of quantitative P-T estimates, combined with the textural evidence for the crystallization sequence of the Al-silicate polymorphs (kyanite \rightarrow sillimanite \rightarrow kyanite) in the pelitic granulite, the deduced P-T path for the Sand Mata granulites is the reverse of that characterizing the Plate tectonic collision zone. It however agrees with the P-T path inferred in the case of the southern Indian granulitic rocks.⁴

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